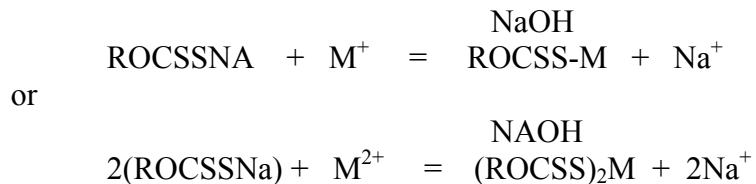


## CHAPTER 6 OTHER PRECIPITATION TECHNIQUES

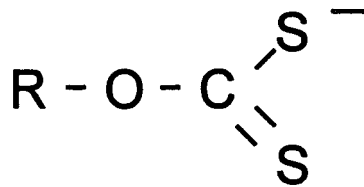
**6-1. Introduction.** Other precipitation techniques discussed below include xanthate precipitation and combined precipitation.

### 6-2. Xanthate Precipitation.

*a.* Heavy metals can also be removed from wastewaters by xanthate precipitation. Xanthate precipitation is a relatively new technology compared to other precipitation methods. Xanthates are sulfonated organic compounds. The xanthate acts as an ion exchange material, where heavy metals ions are replaced with sodium and magnesium. Starch xanthate (SX) treatment has been demonstrated numerous times at full-scale, (EPA, 1989) and has proven ability to remove the following heavy metals:  $\text{Cd}^{2+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Cu}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Ag}^+$ ,  $\text{Zn}^{2+}$  (Anderson, 1994). For mixed-metal solutions, the hierarchy for selective removal of some cations and heavy metals by xanthate precipitation is in the following:  $\text{Na} \ll \text{Ca-Mg-Mn} < \text{Zn} < \text{Ni} < \text{Cd} < \text{Pb} < \text{Cu-Hg}$ . The xanthate-metal precipitation process can be represented as follows:



where  $\text{M}^+$  and  $\text{M}^{2+}$  are the metal ions and NaOH indicates that the reaction occurs at a high pH (pH typically greater than 9.0). ROCSS represents the xanthate material with a chemical structure shown in Figure 6-1, where “R” denotes any organic compound.



**Figure 6-1. Xanthate chemical structure.**

*b.* Xanthate precipitation offers several advantages and disadvantages as outlined in Table 6-1, below. Suggested references for xanthate precipitation include Anderson (1994), and EPA (1989).

**Table 6-1**  
**Advantages and Disadvantages of Xanthate Precipitation**

**Advantages:**

Xanthate precipitation offers a high degree of metal removal (most metals to  $< 0.1$  mg/L).  
Less sensitivity to fluctuations in pH (i.e. metal xanthates do not exhibit amphoteric solubilities).  
Less sensitivity to the presence of complexing agents.  
Improved sludge dewatering properties.  
Capability to selectively remove metals.

**Disadvantages:**

At pH values of less than 3, xanthates decompose rapidly.  
Relatively large amounts of sludge are generated (up to 1000 times the weight of metal).  
Reagent shelf life is relatively short (approximately 7 days).

**6-3. Combined Precipitation.** With the exception of hydroxide precipitation, each precipitation method involves a combined precipitation system, because precipitations are generally performed at a particular pH. For example, when employing sulfide precipitation at pH levels greater than 6.0, hydroxide precipitation can also occur. Numerous bench scale treatability testing studies have been conducted using combined precipitation. A suggested reference summarizing the results of these studies is Anderson (1994).